REMARKS

Favorable reconsideration and allowance of the present application are respectfully requested in view of the foregoing amendments and the following remarks.

First, the Title of the application has been changed to "Method for Rapidly Heating and Cooling Semiconductor Wafers," while the specification has been amended in this paper to specify that the parent application, U.S. Application Serial No. 09/197,284, is now abandoned. Additionally, two inadvertent references to numeral 60 as a "heating device" rather than a "cooling device" at page 15 have been corrected in the specification. This amendment finds support in the original specification, for example, at pages 15 and 16. Further, independent claim 21 has been cancelled in this paper, while new claims 22-44 have been added.

New independent claim 22, for instance, is directed to a method for rapidly heating and cooling semiconductor wafers in a thermal processing chamber. In the method of claim 22, a semiconductor is placed in a substrate holder contained in a thermal processing chamber, and the semiconductor wafer is rapidly heated to a predetermined temperature using a heat source. The semiconductor wafer is then cooled using an active cooling device. The cooling device of claim 22 comprises a cooling member maintained at a temperature lower than the wafer, and the cooling member defines one or more cooling channels for circulating a cooling fluid therethrough and defines one or more gas passages for flowing a cooling gas therethrough. The one or more gas passages are configured to direct the cooling gas towards the semiconductor wafer and the substrate holder so that the cooling gas contacts the semiconductor wafer and cools the wafer.

In the Office Action, independent claim 21 (now cancelled) was rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,662,469 to Okase, et al. Okase, et al. is directed to a thermal processing method wherein a cylindrical process tube has at one end an entrance/exit and at the other end a heat source. Thermal processing is performed on a workpiece brought in from the entrance/exit of the processing tube to a prescribed position inside the tube. Okase, et al. describes that if the actual processing temperature at a certain position changes while the workpiece is

undergoing thermal processing, the workpiece is moved with respect to the heat-generating source in order to return the processing temperature to a particular, prescribed processing temperature. Okase, et al. states that this ensures that the temperature of the workpiece can be rapidly raised to the prescribed processing temperature or, if the temperature of the workpiece changes, it can be rapidly returned to the prescribed processing temperature.

Okase, et al. is focused on providing a thermal processing method and apparatus that enables a rapid increase in the temperature of the workpiece up to a prescribed processing temperature. Okase, et al. accomplishes this through movement of the workpiece, specifically by lifting a workpiece from what it calls the "second side" of its process tube towards the "first side" of its process tube, where a flat heat generation source is located at this "first side" or first end of the processing tube. Thus, a wafer elevator section (i.e., 110) brings the workpiece and the flat heat generation source into close proximity with each other. (See, e.g., col. 5, lines 1-11). Overall, Okase, et al. describes a heating region inside its processing tube that has a temperature gradient which progressively lowers from the first side of the process tube (where the flat heat generation source is located) to the second side of the process tube.

With regard to "cooling," the Office Action pointed to column 13, lines 33-43 of Okase, et al. There, in Embodiment 2, Okase, et al. describes a cooling chamber 140 (shown in Figure 4) which may be incorporated into its apparatus. This cooling chamber 140 is completely separate from Okase, et al.'s actual thermal processing chamber (i.e., process tube 12) where rapid heating and thermal processing of a workpiece occur. Specifically, cooling chamber 140 is located at the bottom of Okase, et al.'s apparatus in the wafer conveyor section 70, well away from thermal processing section 10. (See Figures 1 and 4). For a wafer to even reach cooling chamber 140 after thermal processing, it must be conveyed out from reception chamber 100, through gate valve 93, into load lock chamber 90, and through gate valve 142. Okase, et al. generally states that the cooling method used within cooling chamber 140 could be one using a cooling gas, a cooling jacket, or cold plates.

Applicant respectfully submits that Okase, et al. does not disclose or suggest a method for rapidly heating and cooling semiconductor wafers in a thermal processing chamber according to Applicant's independent claims 22 and 44 and the corresponding dependent claims. For example, Okase, et al. fails to disclose or suggest the step of cooling a semiconductor wafer in a thermal processing chamber using an active cooling device, where the cooling device (1) comprises a cooling member maintained at a lower temperature than the wafer, where that cooling member (2) defines one or more cooling channels for circulating a cooling fluid therethrough and (3) defines one or more gas passages for flowing a cooling gas therethrough, and wherein (4) the gas passages are configured to direct the cooling gas towards the semiconductor wafer and substrate holder so that the cooling gas contacts the semiconductor wafer and cools the wafer.

Generally, Applicant's claimed methods include rapidly heating and cooling a semiconductor wafer in the same thermal processing chamber, and using a very specific active cooling device that directs cooling gas towards a semiconductor wafer so that the cooling gas contacts the wafer and cools it. Applicant's claimed methods seek to reduce the length of time it takes to complete a heating cycle in a thermal processing chamber by actively and rapidly cooling semiconductor wafers in a thermal processing chamber after the wafers have been heated. (See Appl. p. 3, lines 2-28; p. 8, line 14 – p. 9, line 3; p. 16, line 29 – p. 17, line 16). In short, no such method is described by or suggested by Okase, et al. Applicant respectfully submits, then, that new claims 22-41 are not anticipated by Okase, et al.

In summary, Applicant respectfully submits that the present claims patentably define over the prior art of record for at least the reasons set forth above. As such, it is believed that the present application is in complete condition for allowance and favorable action, therefore, is respectfully requested. Examiner Toledo is invited and encouraged to telephone the undersigned, however, should any issues remain after consideration of this Amendment.

Please charge any additional fees required by this Amendment to Deposit Account No. 04-1403.

Respectfully submitted,

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